REMARKS

Claims 1-19 are pending in the present application, with Claims 2-5 withdrawn from consideration at this time. Claims 1, 13 and 14 are amended herein. Support for the amendment to Claim 1 can be found, e.g., at page 3, lines 19-22. Support for the amendments to Claims 13 and 14 can be found, e.g., at page 19, lines 5-22.

Objections to the Specification

The Examiner found that the title of the application is not descriptive of the claimed invention. Applicants have amended the title herein, as suggested by the Examiner.

Objections to the Claims

The Examiner objected to Claims 13 and 14 for the recitation of depositing aluminum oxide in silicon oxide. The Examiner points out that the corresponding disclosure in the specification refers to the percentage of aluminum oxide in the insulating material that comprises aluminum oxide and silicon oxide. Solely to facilitate prosecution, Applicants have amended Claims 13 and 14 to refer to the deposition of aluminum oxide to form an insulating material comprising silicon dioxide and between about 23% and 37% aluminum oxide by weight.

Rejection of Claims

Claims 1 and 6-19 were rejected under 35 U.S.C. §103(a) as obvious in view of the combination of Gates (U.S. Patent No. 6,203,613) and Ritala (Chem. Vap. Dep. 5:7-9 (1999)). In making the rejection, the Examiner found that Gates teaches a method of fabricating trench isolation structures including filling the trenches by an atomic layer deposition (ALD) process. While Gates does not teach completely filling the trenches, the Examiner found that Ritala teaches that trenches can be completely filled with insulating material using ALD. The Examiner concluded that it would have been obvious to completely fill the trenches in the semiconductor substrate of Gates.

Claim 1 is directed to a method of fabricating trench isolation structures between integrated electrical devices. The present amendment to Claim 1 reinforces this context, and Claim 1 now recites "completely filling the trenches with insulating material by atomic layer deposition to form a trench isolation structure." Claims 6-19 all depend from Claim 1.

Applicants submit that there is no teaching or suggestion in Gates that would motivate one of skill in the art to attempt to form a trench isolation structure by an ALD process. Gates teaches the use of metal nitrate-containing precursors in ALD processes for forming dielectric layers or barrier layers. Contrary to the Examiner's assertion, there is no teaching or suggestion in Gates of fabricating trench isolation structures, much less a suggestion to fill trenches by an ALD process. Rather, Gates is directed to the use of ALD processes to deposit very thin films with fine control of the thickness. For example, Gates focuses on the ability to form dielectric and barrier layers with a thickness in the range of 1 to 10 nm (column 4, lines 22-32 and column 5, lines 17-24).

Ritala does not make up for the deficiencies of Gates. Ritala is a scientific paper that is concerned with the ability to deposit conformal films by ALD. While Ritala utilizes trenches to demonstrate the conformal nature of ALD, there is no teaching or suggestion in Ritala of completely filling those trenches by ALD to form trench isolation structures between integrated electrical devices in a semiconductor substrate, as claimed.

The combination of Gates and Ritala can not teach or suggest forming a trench isolation structure as claimed because neither Gates nor Ritala teach or suggest using ALD to deposit an insulating material in a trench to form a trench isolation structure. Thus, Applicants request withdrawal of the present rejection.

Criticality

The rejection of all claims is believed to be overcome by the argument presented above. However, in rejecting dependent Claims 13-14 and 17-18, the Examiner argues that the specification contains no disclosure of the critical nature of the claimed subject matter and concludes that it would have been obvious to form the claimed insulating material "in any combination" to achieve a superior isolation. Applicants would like to point out for the record that the specification clearly teaches that the subject matter of Claims 13-14 and 17-18 enables achievement of trench isolation structures with a desired property: the ability to withstand large changes in temperature at the interface of the insulating material and the semiconductor substrate.

The specification teaches that in conventional trench isolation structures, the differences in the CTE of the insulating material and the semiconductor substrate can be problematic and

that the present invention provides a way to avoid these problems (page 7, lines 20-30). In particular, the specification teaches that if a CTE is chosen that is within about 20% of the CTE of the semiconductor substrate, the trench isolation structure is able to withstand large changes in temperature at the interface of the insulating material and the semiconductor substrate (page 19, lines 1-4). Claim 18 refers to producing an insulating material with a CTE that is within about 20% of the CTE of silicon. Thus, the specification clearly teaches the criticality of the claimed CTE to obtain a trench isolation structure with the desired properties.

Further, the specification teaches that an insulator CTE within about 20% of the CTE of silicon can be obtained with an aluminum oxide concentration of between about 23% and 37% by weight in an insulating material comprising aluminum oxide and silicon oxide and that a CTE of within about 10% of the CTE of silicon can be obtained with an aluminum oxide concentration of between about 26% and 34% by weight (page 19, lines 12-22). A concentration of aluminum oxide of about 23% to about 37% by weight is disclosed to correspond to an insulating material comprising about 25% to about 50% mullite by weight, after phase transformation. Claim 13 recites a percentage of aluminum oxide of about 23% to about 37% by weight, Claim 14 recites a percentage of aluminum oxide of about 26% to about 34%, and Claim 17 recites a percentage of mullite in the insulating material. Thus, the specification clearly teaches that the concentrations of aluminum oxide and mullite recited in Claims 13, 14 and 18 are "critical" in that they facilitate the desired CTE with an insulating material comprising aluminum oxide and silicon oxide.

The claimed features are clearly disclosed to be linked to production of a trench isolation structure with a desired property. Further, as the prior art cited by the Examiner fails to appreciate the desirability of a trench isolation structure comprising an insulating material with a CTE close to that of the underling semiconductor substrate, the references provide no motivation to produce an insulating material with the claimed features. Thus, Applicants submit that Claims 13-14 and 17-18 are not obvious in view of the cited references.

Conclusion

In view of the amendments and arguments presented above, Applicants submit that the pending Claims are in condition for allowance. If, however, some issue remains that the

Examiner feels can be addressed by Examiner's amendment, the Examiner is cordially invited to call the undersigned for authorization.

Respectfully submitted,

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